U. S. FOREST SERVICE

RESEARCH NOTE NC-28

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

Folwell Avenue, St. Paul, Minnesota 55101

Chemical Weed Control in a Two-Year-Old Walnut Planting

ABSTRACT. — Six herbicide mixtures were sprayed directly on broadleaf weeds and grasses competing with black walnut trees. Mixtures of paraquat (½ lb/acre) with simazine (4 lb/acre) or atrazine (4 lb/acre), and amitrole (2 lb/acre) plus simazine (4 lb/acre) gave satisfactory weed control, which resulted in significantly better tree height and diameter growth.

Grasses and broadleaf weeds compete with young black walnut (*Juglans nigra* L.) trees for moisture and nutrients, and are often the most important site factor affecting tree growth.

In May 1965 we established an experiment to evaluate several combined herbicide treatments for weed control around 2-year-old walnut trees and to learn whether the treatments produced any phytotoxic symptoms on the trees.

The Study

Sixty-three 2-year-old trees grown from nuts that were sown on a cleared forest site in east-central Iowa were studied. The trees are on a northeast slope in a Fayette silt loam soil.

The major weed species present at the time of establishment were: nimblewill (*Muhlenbergia schreberi* Gmel.), Kentucky bluegrass (*Poa pratensis* L.), yellow nut-grass (*Cyperus esculentus* L.), blue violet (*Viola cucullata* Ait.), strawberry (*Fragaria virginiana* Duches.), yellow wood sorrel (*Oxalis europaea* Jord.), silvery cinquefoil (*Potentilla argentea* L.), horse nettle (*Solanum carolinense* L.), daisy fleabane (*Erigeron strigosus* Muhl.), and poison ivy (*Toxicodendron radicans* (L.) Kuntze). Many other annual and perennial weeds, grasses, and small woody plants were also present but they occurred as scattered individuals. The weed species did not overtop even the smallest walnut trees when treatments were applied.

Three quick-killing systemic herbicides that control weeds for short periods were combined with two soil sterilants that control weeds and grasses for longer periods.[1]

1. Amitrole 2 lb/A, and simazine 4 lb/A.
2. Amitrole 2 lb/A, and atrazine 4 lb/A.
3. Paraquat ½ lb/A with Ortho X-77 spreader, and simazine 4 lb/A.
4. Paraquat ½ lb/A with Ortho X-77 spreader, and atrazine 4 lb/A.
5. Dalapon 4 lb/A, and simazine 4 lb/A.
6. Dalapon 4 lb/A, and atrazine 4 lb/A.
7. Control—no herbicide.

Weed control treatments were applied to three size classes of trees (diameters measured 2 inches above ground):

Tree size class	*Height (feet)*		*Diam. (32nd inch)*	
	Av.	*Range*	*Av.*	*Range*
I	1.4	1.0-2.3	10	6-17
II	3.1	2.4-3.6	21	18-28
III	4.9	3.7-5.8	33	29-41

Seven weed control treatments were replicated three times for each of the three size classes. Treatments were randomly assigned to individual trees in each size class.

During May 25-28, 1965, the herbicide mixtures in water solutions and suspensions were sprayed on the foliage of the ground vegetation over a 6x6-foot plot around each walnut tree. Two quarts of spray solution at the required concentration were applied with a back-pack sprayer to each plot. The walnut

[1] *The herbicides were (1) amitrole (3-amino-1, 2, 4-triazole), (2) paraquat (1, 1'-dimethyl-4, 4'-dipyridylium dichloride), and (3) dalapon (2, 2-dichloropropionic acid). The soil sterilants were (1) simazine (2-chloro-4, 6-bis (ethylamino)-s-triazine) and (2) atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine). All rates are given in active ingredients. The 80-percent wettable powders of simazine and atrazine were used. Eight ounces of Ortho X-77 Spreader per 100 gallons of spray solution were used with the paraquat treatments.*

foliage was carefully avoided, but not the walnut stems.

Total heights and diameters of trees were measured on May 5 and October 15, 1965, and September 28, 1966. Periodically in 1965 each plot was rated for weed control. Final yields of grasses, broadleaf weeds, and poison ivy were harvested September 11-15 from a 1-foot-square plot on the south side of each tree.

Results

Weeds. — All of the treatments tested were effective in controlling competing vegetation, but there were differences in quickness of kill and length of time weed growth was suppressed (table 1). Treatments with paraquat killed grasses and broadleaf weeds within 4 to 5 days, while treatments with amitrole and dalapon gave a much slower kill. Treatments with atrazine generally gave quicker kills and suppressed weeds longer than treatments with simazine.

September grass yields for all combined treatments except the amitrole-simazine treatment were significantly lower than those for the control treatment (table 2). In mixtures with amitrole, atrazine gave better residual control of grasses than simazine. The amitrole-simazine treatment was effective until August, but thereafter there was considerable regrowth of grass. Nimblewill, a perennial grass that is resistant to amitrole, accounted for most of this grass weight.[2] The amitrole-atrazine mixture apparently was more effective against nimblewill grass than the amitrole-simazine mixture. Planned orthogonal comparisons between chemically treated plots and control plots showed that chemical treatments significantly reduced broadleaf weed and total weed yields.

Treatments with paraquat and amitrole gave effective control of poison ivy initially, but at least one more treatment would be required to eradicate it. The heavy growth of grasses and weeds on control plots apparently restricted the growth of poison ivy.

Most combined treatments held broadleaf weeds and grasses in check until August, but all treatments failed to suppress new weed growth the following spring.

Trees. — Effective control of broadleaf weeds and grasses by the chemicals significantly increased height and diameter growth of black walnut trees in 1965 (table 3). Mean height growth ranged from 1.7 feet on the controls to 3.2 feet for the amitrole-simazine treatment. Mean diameter growth of walnut trees was 6/32-inch better on amitrole-simazine plots and on plots treated with the paraquat mixtures than on control plots.

[2] *Dunham, R. S. Herbicide manual for non-cropland weeds. U.S. Dep. Agr., Agr. Handbook 269, p. 7. 1965.*

Table 1. — *Average weed control around black walnut trees by treatments and 1965 observation date*

Weed control treatments[1/]	Weed control rating on-- [2/]			
	June 9	July 1	August 4	September 1
Paraquat ½ lb/A and atrazine 4 lb/A	10.0	10.0	8.6	8.0
Paraquat ½ lb/A and simazine 4 lb/A	10.0	9.2	8.1	6.7
Amitrole 2 lb/A and atrazine 4 lb/A	7.2	9.1	7.4	4.6
Amitrole 2 lb/A and simazine 4 lb/A	6.1	8.2	7.0	3.4
Dalapon 4 lb/A and atrazine 4 lb/A	8.0	8.0	7.6	7.2
Dalapon 4 lb/A and simazine 4 lb/A	5.7	7.3	6.1	4.7
Control--no herbicide	0.0	0.0	0.0	0.0

1/ Includes all herbaceous vegetation and poison ivy averaged over all tree classes. Treatments were applied on May 25-28, 1965.

2/ 0 = No control and 10 = nearly complete control.

Table 2. — *Average grass, weed, and poison ivy yields in September 1965 by weed control treatments*[1]
(In grams)

Weed control treatment	Oven-dry weight per square foot[2]			
	Grass	Weeds	Poison ivy	Total
Paraquat ½ lb/A and atrazine 4 lb/A	.85	.00	2.27	3.12
Amitrole 2 lb/A and atrazine 4 lb/A	.97	.18	2.76	3.91
Dalapon 4 lb/A and atrazine 4 lb/A	1.31	.01	1.42	2.74
Dalapon 4 lb/A and simazine 4 lb/A	1.96	2.03	3.12	7.11
Paraquat ½ lb/A and simazine 4 lb/A	3.64	.06	2.12	5.82
Amitrole 2 lb/A and simazine 4 lb/A	[3] 10.03	.48	1.42	11.93
Control--no herbicide	11.76	15.69	1.39	28.84

1/ All tree classes combined.

2/ Means connected by a bracket are not significantly different from each other at the 5-percent level.

3/ Includes some dead nimblewill foliage.

Table 3. — *Mean height and diameter growth of black walnut trees by weed control treatments and years*[1]

Weed control treatment	Growth 1965[2]		Growth 1966[2]		Total 1966[2]	
	Height	Diameter	Height	Diameter	Height	Diameter
	Feet	32nd inch	Feet	32nd inch	Feet	32nd inch
Amitrole 2 lb/A and simazine 4 lb/A	3.2	16	2.1	12	8.4	49
Paraquat ½ lb/A and atrazine 4 lb/A	3.0	16	2.1	14	8.3	53
Paraquat ½ lb/A and simazine 4 lb/A	2.8	16	2.0	12	7.9	50
Amitrole 2 lb/A and atrazine 4 lb/A	2.3	15	2.3	12	7.7	48
Dalapon 4 lb/A and simazine 4 lb/A	2.3	14	2.0	11	7.5	46
Dalapon 4 lb/A and atrazine 4 lb/A	2.5	13	2.0	10	7.6	45
Control--no herbicide	1.7	10	2.2	9	7.0	39

1/ All tree classes combined. Diameters were measured 2 inches above ground line.

2/ Means connected by a bracket are not significantly different from each other at the 5-percent level.

Height growth in 1966 was similar for chemically released trees and control trees, but previously released trees maintained their initial advantage with respect to total height. Chemically released trees were still growing faster in diameter than were control trees during the second growing season after treatments were applied.

In 1965 trees in the large tree classes (I & II) grew two to three times faster in height and diameter than trees in the smallest class (table 4). During the second year, trees from the largest tree class increased their advantage in both height and diameter over trees in the smallest class.

Table 4. — *Mean height and diameter growth of black walnut trees by tree classes and years*[1]

Tree class	Growth 1965[2/]		Growth 1966		Total 1966	
	Height	Diameter	Height	Diameter	Height	Diameter
	Feet	32nd inch	Feet	32nd inch	Feet	32nd inch
III	3.9	21	[3/]2.6	[4/]15	11.4	69
II	2.5	14	2.1	11	7.6	46
I	1.2	8	1.6	9	4.3	26

1/ Over all weed control treatments. Diameters were measured 2 inches above ground line.

2/ All differences in growth among tree classes are significant at the 5-percent level.

3/ Significantly better (5-percent level) than tree class I.

4/ Significantly better (5-percent level) than tree class I or II.

The best tree (class III tree on an amitrole-simazine plot) grew 11.4 feet in height and 1.5 inches in diameter in 2 years. This tree was 16.8 feet tall and had a diameter of more than 2.6 inches at the end of the 1966 growing season.

There was no evidence of chemical injury to the trees from any of the treatments tested.

Summary and Recommendations

1. Trees released from herbaceous vegetation grew nearly twice as much in height and half again as much in diameter as control trees during the season of chemical application.

2. The smallest trees benefited from release, but they failed to gain on unreleased trees in the next tree class. Obviously, it would not pay to release small trees if there are enough well-spaced, high-quality trees from the larger tree classes available.

3. Of the weed control mixtures studied, paraquat-simazine, paraquat-atrazine, and amitrole-simazine[3] resulted in the best tree height and diameter growth.

4. Spray solutions must be kept off walnut foliage to avoid injury.

5. Best walnut growth responses can be obtained by matching herbicides with weed species and soil conditions in the plantation. Use mixtures with paraquat when both broadleaf weeds and grasses are equally troublesome. Amitrole mixtures are recommended for broadleaf weed and quackgrass control. Dalapon is useful in mixtures for controlling covers that are predominantly grass.[4]

6. Simazine or atrazine at 4 pounds per acre should be included in mixtures for full season weed control on silt loam soils.[5] Simazine is preferred over atrazine as a residual herbicide because simazine is less subject to leaching.

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[3] *Homemade mixtures can be prepared by buying the herbicides separately and mixing them. A combination of amitrole (2 lb/A) and simazine (4 lb/A) is sold under the trade name of Amizine.*

[4] *Byrnes, W. R. Site preparation and weed control.* In *Black Walnut Culture. U.S. Forest Serv., N. Cent. Forest Exp. Sta., p. 20. 1966.*

[5] *Unpublished data on file at the field office of the North Central Forest Experiment Station in Ames, Iowa.*

GAYNE G. ERDMANN
Associate Silviculturist
LEEROY GREEN
Forestry Technician